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The MONTHLY REVIEW

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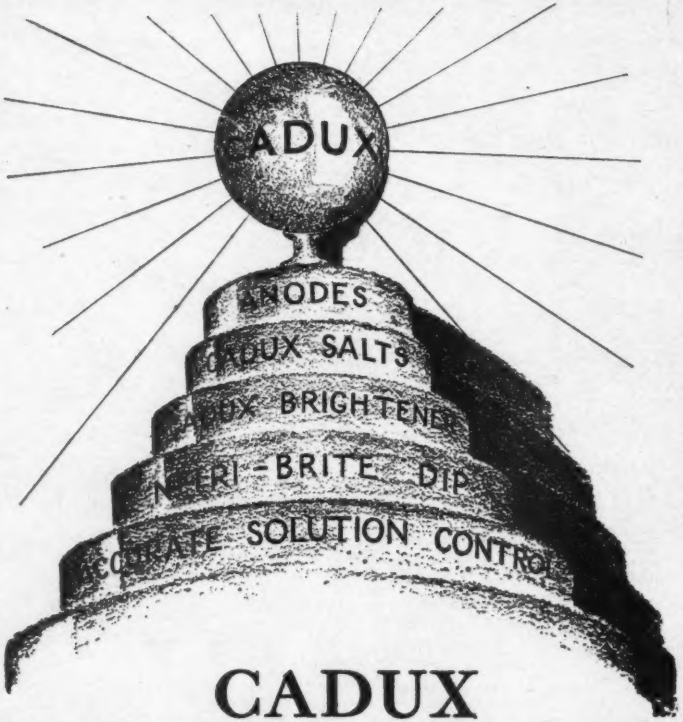

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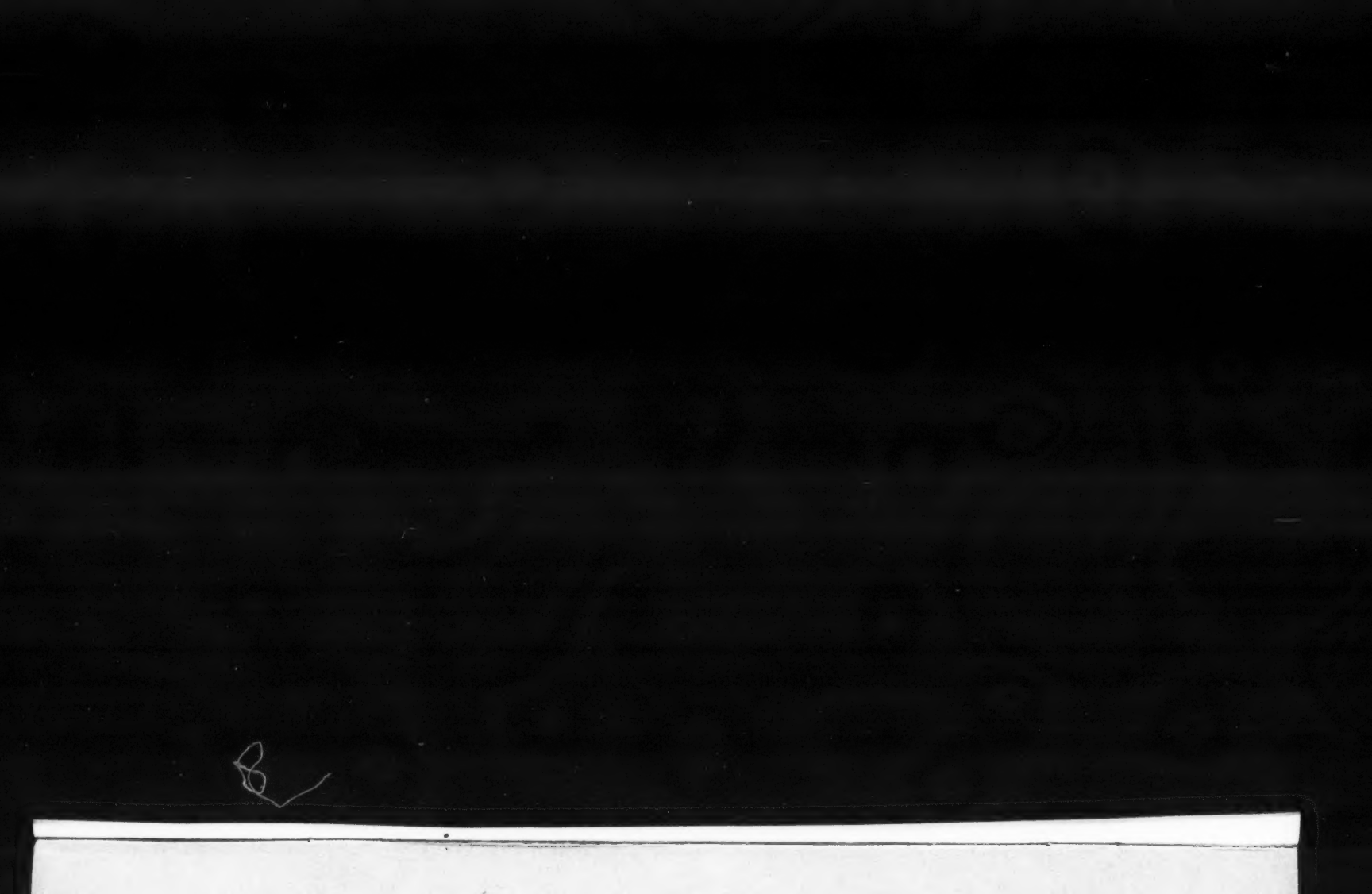

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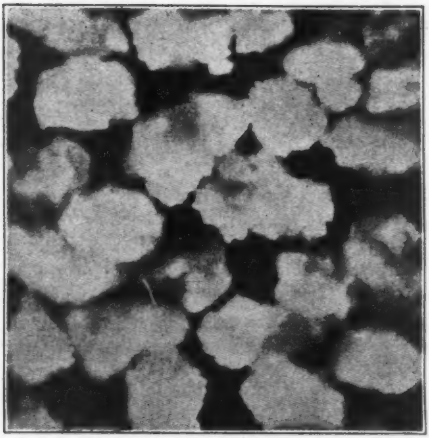

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WHAT IS UNDER THE PLATE?

George B. Hogaboom, Research Engineer
Hanson-Van Winkle-Munning Company, Matawan, New Jersey

FOR several years the subject of analytical control of electroplating solutions was discussed at all the meetings of the American Electro-Platers' Society. The fact that solution control is essential is evidenced by the familiarity with technical terms and methods by platers who, though denied a training in chemistry, converse fluently in terms which a few years ago were often as confusing as Egyptian hieroglyphics. With the knowledge gained through chemical control better solutions were developed and the technique of the preparation and of the handling of work was improved.

When the successful control of solutions became common knowledge, it was natural that the thoughts of platers and chemists turned to the value of electrodeposited coatings. There are two reasons for the electroplating of metals to be considered,—ornamentation and protection against corrosion. These two often became one as both beauty of finish and increase in service duration were demanded for the same object. Stainless steel became a menace as it possessed both of these requirements. The challenge was accepted and a research was instituted to investigate the protection electroplated coatings gave to steel. On steel or iron the value of ornamental electroplated coatings is measured by its protective life against corrosion. A heavily gold plated radiator shell has less value in service than one that is cadmium coated, even though the cadmium be tissue-paper thick.

For about three years a comprehensive investigation has been made of the protective value of electroplated coatings. Yesterday you listened to the results. You must have declared that

the research was comprehensive and worth while, and that this contribution to the electroplating industry is of inestimable value. You have seen the weakness of some coatings, and from the data assembled from others you are beginning to realize the importance of definite specifications for the electroplating of steel. It is needless to predict what the results of this research will be. Further work will be done and you will support a similar investigation of the value of electroplated coatings on non-ferrous metals. You cannot, and I know will not, stop with the protective coatings but will finish the job so that in the very near future coatings, both for ornament and protection, will be so processed that electroplated finishes will be more firmly established than ever. Tomorrow you will be as familiar with plating under definite specifications as you are today with the analytical control of solutions.

The work of improving and strengthening the structure of the art of electroplating of metals is highly commendable. But upon what are we building? We are increasing our knowledge of electrodeposits, but what do we know about the basis metal? We electroplate on iron, steel, zinc, copper, brass, and several other metals and alloys, and know very little about the effect of the foundation (the basis metal) upon the strength and durability of the structure (the deposited metal). We apparently say with the junk man, "Iron is iron, steel is steel, brass is brass." But is that wholly true? We have overlooked the fact that the metals are composed of crystals that seem under some conditions to be alive. Strains are set up in metals when cold worked. These strains often assert themselves. U. R. Evans said, "Cold worked articles, if not annealed, retain internal stresses which may cause unexpected failure when the articles have been in use sometime."[1] In the tin plate industry the sheet steel, after the final cold rolling, is annealed at, not the regular annealing temperature of 1400 degrees F. nor the normalizing temperature of about 1750 degrees F., but at 1000 degrees F. to remove the cold work strains so that after hot tinning the sheet metal can be worked without "increasing the tendency of the surface of the sheet to pull coarse as by the creation of a large-grained, and therefore weak structure."[2]

Cold rolled steel that is to be formed into articles and electroplated comes from the mill cold worked. It is put through forming operations that distort the crystal structure, set up internal

strains, and often "pulls coarse". Some forming operations are more severe than others, so that the internal and the external structure is deformed; yet this steel is sent to the plating room to be given a protective coating or an ornamental finish that must be perfect. No attention has been given to the internal structure or the external condition, yet, when there is the "unexpected failure" the plating process is invariably considered at fault. If the fabricated steel article is annealed often it is heated in an open flame with no attempt to use the same methods of heat treating as would be given to an ordinary machine tool. The electroplating is expected to correct and cover any and all treatments given the steel in the fabrication processes.

In the manufacture of low carbon cold rolled steel too little attention is now being given to that which is to be electroplated. If the steel is not clean and the annealing conditions not controlled, the surface of the steel will have a higher carbon content than the body of the stock. A thin film of steel with as high as .80 carbon may be had on the surface of an .04 carbon cold rolled stock. This film cannot be seen with a microscope but can be detected by the well-known "spark test". This film or "skin" must have an effect upon the character of the deposited metal, especially if the steel is used as a cathode in an electrolytic acid pickle. The effect of hydrogen on high carbon steel under stress is well known. Is it not reasonable to assume that if such a steel were plated with nickel and given an exposure test, that the deposit would fail more rapidly than correctly treated steel? If blisters appear and the underside of them is examined, is it not more correct to state that this "skin" has separated from the basis metal and adhered to the deposit rather than to assume that it is an oxide on the under surface of the blister? Hardened worked surfaces, oxides, and such films as noted are often more adherent to an electrodeposit than to the basis metal. This will be referred to again later.

Suppose a piece of steel that has been cold worked is given an electro deposit of metal. Will the deposit have the same outdoor exposure or salt spray life as a steel that is not in a strained condition? It is well known that steel under a strain will corrode more rapidly. Take the old story of two eight-day clock springs. Wind one and it has the energy to run a clock at least 200 hours. Place both in acid. Where does the energy in the wound spring go? It goes into the acceleration of corrosion. Will not the

same be true of sheet or fabricated metal that has not been annealed to remove the cold worked strains?

What effect has cold working of steel upon its magnetic properties; upon the distribution of current which has a bearing on a uniform thickness of deposit? If an armature of a motor is annealed after assembly to remove cold worked strains, the magnetic properties are increased 15%. Do we know what will be the result if fabricated cold rolled steel or any other metal was annealed to remove cold work strains?

What has been said about steel is undoubtedly true in some degree about all other metals that are fabricated and given to the plater to increase their life or add to their appearance. High brass when cold worked is subject to internal strains. You well know the effect of mercury or ammonia in developing season cracks. Time often acts in the same manner and season cracks develop almost any time after the article has been plated and is in use. Polishing and buffing of brass flows the surface of the metal, and that has an effect upon the adhesion of an electrodeposit. The excellent experiment on the adhesion of electrodeposited nickel to brass made by A. W. Hothersall deserves to be told in his own words. "The influence of the properties of the surface layers of brass on the degree of apparent adhesion of electrodeposited nickel was further illustrated by the following experiment:—A piece of sheet brass was carefully buffed to a high finish; the polished layer on one-half of the specimen was then removed by rubbing with a medium grade of emery cloth, the other half being protected from accidental scratches by means of gummed paper. The specimen was cleaned by treatment A, and nickel deposited to a thickness of about 0.030 inch. After sawing off the edges of the coated specimen and turning up one corner of the deposit, the nickel could be pulled off the emeried portion with the fingers, but it adhered fairly strongly to the buffed area, and had to be twisted off with pliers. The underside of the deposit was coated with a brass colored film both in the area which had been in contact with the emeried half and also that which had covered the buffed half. The adhesion of the nickel deposit was thus greater than the shear strength of the surface layers of both the buffed portion and the emeried portion. Examination under a microscope of the brass surface from which the nickel deposit had been torn showed that the surface layers had been removed in such a way as to expose the rolled structure

of the metal, both in the emeried and the buffed parts of the specimen."[3] In view of that research any test made will be incomplete unless the condition under the electroplate is known. This will include surfaces that have been polished, buffed, or worked in any similar manner.

If we go into a polishing or buffing room today we see a line of lathes operated from a common shaft, or if the lathes are motor driven, the speed of each lathe is about the same. Wheels or buffs are used of an indescriminate size. How much attention is given to the peripheral travel? This is arrived at more by the shape of the article to be finished than by a study of what may occur to the surface of the metal, and later to the electroplated coating. Today the aim seems to be to have as large a wheel or buff as the lathe will carry; to make the buff as hard as possible by all manner of sewing; and to operate at a speed that creates a frictional heat just below the burning point. In fact, if a fire-proof buff is available, still higher speeds will be used. How does such a set-up affect the surface of the metal? Listen to what U. R. Evans says about this:—"At one time polishing was regarded as a kind of minute abrasion; the projecting portions of the rough surface, it was thought, worn away by the action of the polishing material. It has however, been shown that polishing generally consists in making the material flow down from the minute projections on the surface, and fill up, or cover up the depressions. Thus, when the polishing is complete, the whole surface is covered over with a smooth vitreous layer of more or less 'amorphous' metal, produced by the action of cold work. . . . . An interesting experiment concerns the polishing of a specimen of copper, the surface of which contains numerous pits, due to gas included in the metal at the time of casting. When the surface is polished the pits disappear, the amorphous film having flowed over and hidden them, ... When the film was removed the pits reopened, with the same appearance as at the start."

Speaking about other mechanical workings of metals, Evans says, "Many authorities have long believed that the added strength of the cold drawn (copper) wire is due to a hard glassy skin of amorphous copper on the surface. Doubt has, however, been thrown on this view by recent investigations, the hard skin, where it exists at all, appears to be due to oxide scale rolled into

the wire. In the case of a brass tube, on the other hand, the existence of an apparently amorphous surface layer appears to be established. It has, in fact, been found possible to strip the layer from the granular material below by the action of dilute ammonium chloride."[4]

We know something of the effect of this "amorphous" layer on the structure of an electrodeposit metal. This was clearly shown by Blum & Rawdon, and photographs of a deposit of copper on copper before and after this layer was removed are found in the text on electroplating by William Blum and the author of this paper.[5]

In a buffing room recently visited spun copper percolators having a soft metal spout were buffed with a 16-inch wheel on a lathe run at 2400 r.p.m. The percolators were cleaned and nickel-plated in the regular way, color buffed and chromium plated. The nickel deposit adhered well but the soft metal spout was covered with "hair line" cracks typical of chromium deposits. The cause of these "hair line" cracks was the condition of the surface of the soft metal due to the buffing operations. The plastic deformation of the surface of metal by buffing created a strained condition which asserted itself after the electroplating. This will be illustrated by a micrograph later. This may lead the way to learning the cause of "hair line" cracks on some metals, especially high brass. It has been pointed out that brass flows under the buffing operation and if this flowed surface is not removed before electroplating may it not be the cause of "hair line" cracks in the chromium deposits? This surely makes the question of "What is under the plate" pertinent.

Reference was made to the oxide coating on copper. What about the oxide coatings that may be invisible on any metal that is to be electroplated? They are formed easily in the fabricating or the polishing operations. Hedges tells us, "In fact, solutions of alkali render iron definitely *passive*, which, as will be shown later, is due to the formation of a highly protective film of ferric oxide or hydroxide."[6]

Recently an investigator stated that metal cleaned in an alkaline electric cleaner became passive due to the formation of an oxide film. Are these oxide films that render the surface of a metal passive entirely removed previous to the electrodeposition of a metal? Not only will the passivity of the surface of the metal affect the adhesion of an electroplated coating, but the

oxide film not being adherent to the basis metal will be the cause of blistering, peeling, and the "unexpected failure" in service. It will be shown that the oxide films, even though invisible to the eye, can be removed as films from a metal.

These invisible oxide films also affect the conductivity of metals. Soderberg told of his experience with cadmium plated copper electrical contacts. The cadmium was deposited over an invisible oxide film and this increased the electrical resistivity of the copper 225 times. Aluminum is given an oxide film for that very purpose. These oxide films are often under the plate.

There may be a condition on the surface of metal that will retard or entirely prevent the deposition of metal on some parts of an article. This is generally due to the cold working at a certain place. A picture will be shown of a curtain rod made of 3/8 inch steel wire. This wire is purchased in coils and run through a straightener in which the dies rotate around the wire forming a narrow spiral band of worked metal. The rod is rolled to obtain a bright finish, cleaned and pickled. The spiral worked spot will not cover in a brass solution for fully five minutes after the other area has a good brass color. When it is plated it will be found that the spiral band has a very light plate and if a piece of the rod is immersed in a cyanide solution the deposit on this worked surface will soon be removed. In service this weak band of brass being porous will oxidize or rather discolor more rapidly than the other part of the rod and a distinct bare line will develop where the dies of the straightener have worked the surface of the steel. In the electroplating of sheet steel that has been run through a machine to flatten, in which there is a narrow roller guide, the same bare space is had where the surface is cold worked. The reason for this is that the worked area has a higher potential than the surrounding areas. The difference in potential not only affects the plating, but in any corrosion test or in service, the rate of corrosion is increased of both the plated coating and the basis metal. This again is a condition under the plate.

In the beginning of this paper it was stated that metal seemed to be live. In his novel and conclusive work on electrodeposited coatings Castell found that a copper electroplate did not remain all copper when deposited upon zinc — e.g. a zinc base die casting. It has been almost universally assumed that a copper deposit on a zinc die casting was absorbed by the zinc. Castell found

that the opposite was the case — the copper absorbed the zinc. Next to the zinc basis metal an alloy forms that is high in zinc and low in copper and the percentage of copper increases for some distance forming a yellow brass, a zinc bronze — the top layer is pure copper. The phenomenon occurs slowly while the article is in service. The rate depends upon the temperature to which the die casting is exposed. Heating to 500 degrees F. accelerates the rate of absorption. The alloy next to the basis metal is very brittle and under conditions over which in service there is no control, blisters and peeling of the copper and nickel deposits will occur. The nickel does not separate from the copper, but the copper deposit with the absorbed zinc separates from the basis metal. It need not be stated how often this blistering and peeling has been attributed to poor cleaning or to an unbalanced plating solution — the fault of the plater.

If the die casting itself is investigated an interesting phenomenon occurs that affects the electrodeposit whether it be nickel alone or nickel with a flash or a heavy deposit of copper under it. The impurities or metals added purposely in the zinc alloys may bring about an internal condition in the fabricated die casting that will cause the electrodeposit to blister or peel. The presence of tin in small quantities, even as low as .01% has a detrimental effect on the internal structure of the die casting which in time will assert itself. At one time tin was purposely added to zinc in making die casting to make it "more fluid". It is now known that even traces of tin must be kept out, and by doing this the plater has been proven not guilty of neglect in his operations. It is essential that the best alloy obtainable is the only safe one to use for zinc base die castings that are to be electroplated. Such an alloy has been developed through research and the electroplater is indebted to the metallurgist for telling him what is under the plate. A photograph illustrating this phenomenon will be shown.

Zinc alloys are not the only alloys in which internal changes occur. Antimonal-lead is another troublesome alloy. At 247 degrees C. 2.45% of antimony will be dissolved in lead — this is the eutectic. When the temperature of this alloy is decreased to what is commonly called "room temperature", the amount of antimony held in solution is practically one-tenth of that in the alloy at the higher temperature or 0.25%. This free antimony is dispersed throughout the alloy, but as heat is applied or as

the alloy "ages" with time this segregated antimony begins to get together in larger amounts and soon there will be definite areas of pure antimony and pure lead. This goes on under the plate regardless of whether the antimonal-lead has been made to appear like a noble metal by being given a mantle of pure gold.

Aluminum will dissolve about 6% of copper and when this mixture is alloyed with other metals the very useful duralumin is made. If the surface of duralumin is burnished, buffed, or worked in some similar manner the surface no longer contains 6% of copper — some of the copper has been precipitated and a different percentage alloy has been formed. This will be told in detail in a coming issue of "Metals & Alloys" by Dr. Phillips, Yale University. Previous to electroplating many alloys are cold worked, polished, buffed, or burnished. Is there a change on the surface of the alloy and if so what effect has that upon the adherence and the protective value of an electrodeposited coating?

This story is but an assembly of known metallurgical facts but one that has not been given the thought and consideration it should have received. The application of these phenomena — these known facts — to electroplating will construct a foundation upon which the real structure of electroplating can be erected. All assembled data on the physical characteristics of electrodeposits and the protection against corrosion of electroplated coatings will lose part of their value unless more is known about what is under the plate.

1. Metal & Metallic Compounds—U. R. Evans, 1923, Vol. 1, p. 186
2. Sheet Steel & Tin Plate—R. W. Shannon, 1930, p. 131
3. Transactions of Electroplaters & Depositors Technical Society, May, 1932.
4. Metal & Metallic Compounds-U. R. Evans, 1923, Vol. 1., pp. 172-173
5. Principles of Electroplating & Electroforming, Blum & Hogaboom, p. 111, 1930.
6. Protective Films on Metals—Ernst S. Hedges, 1932, p. 38.

Mr. Hogaboom will be glad to address any Branch on the above subject and illustrate it with fifty or more slides. Communications should be sent direct to George B. Hogaboom.

PROTECTIVE VALUE OF PLATED COATINGS ON NON-FERROUS METALS

Read by Dr. Wm. Blum

Detroit Convention 1934

On March 8 a conference was held in Washington upon specifications for plated coatings. The result of the exposure tests on steel were reviewed and recommendations were made to a joint committee of the American Society for Testing Materials and the American Electro-Platers' Society, of which W. M. Phillips was Chairman.

Attention was called to the lack of definite information regarding the value of plating on non-ferrous metals, especially zinc-base die castings. The recommendation was made unanimously that extensive exposure tests and laboratory studies should be made on this subject. It was then stated that the Bureau of Standards will gladly cooperate in such a study, provided the industry will furnish the services of a research associate, which has been done in the past few years through the American Electro-Platers' Society. Pending the formulation of such plans and the raising of funds, it is not possible to decide on the details of such a program. The following outline indicates its probable scope.

Exposures will be made on the existing racks in the same six locations. There is room in each place for 112 sets of five specimens each. It is proposed to divide these between specimens having as the base metals, steel, copper, brass, zinc and die-castings.

The inclusion of plated steel will serve (a) as a check on the first series, (b) as a basis of reference for comparing steel and other metals, and (c) as an opportunity to try coatings or conditions that were not included in the previous series.

The plated brass specimens may include rolled, extruded and cast brass, and possibly 18 per cent nickel brass (or nickel silver). Typical zinc-base die-castings will be used.

For each base metal, the effects of variations in the preparation, composition, thickness, and method of depositing the coatings will be determined. Accelerated and other laboratory tests will be included. The detailed schedule will be circulated for comment before it is carried out.

It was estimated that about $5,000 per year for two years will be required to complete the program, including salary and

traveling expense of the research associate and special supplies and equipment. As above indicated, the Bureau will be glad to cooperate in such a study if the demand from, and support by, the interested industries is sufficient.

I think that with this brief outline Mr. Strausser and I will attempt to answer any questions that you have on these three phases of our work.

CHAIRMAN THOMPSON: Gentlemen, we have heard the able delivery of the report of the stewardship of the Research Division. With regard to any future research work that our organization may undertake, now is the time to get the correct picture in your minds as to the possibilities of it. For that reason we will devote a reasonable amount of time to your interrogations.

Dr. Blum suggests that the questions that have occurred upon the presentation of the papers on Exposure Tests be asked at this time.

DELEGATE F. J. HANLON (Chicago Branch): Is it possible for you or your associate at this time to give a definite established deposition on your investigation that we could go out and sell to our customers as one that would be reasonably safe from rust?

DR. BLUM: I will answer that question. It leads up to the next point on the program, and if we just answer it partially you will understand that it is going to be taken up later.

The logical way to apply information derived from a study of this kind is in the form of specifications, and, while many particular firms or organizations have specifications at the present time, there is a lack of uniformity and consistency, so the A. S. T. M. and the Electro-Platers' Society each have committees, of which Mr. Phillips is Chairman of each, so it is in effect a joint committee, that are now engaged in drawing up specifications for plating on steel, and I am going to suggest that we postpone this question until Mr. Phillips' remarks, when I feel sure he will refer to it.

DELEGATE GEORGE GEHLING: Did you make any hot dip tests?

DR. BLUM: We did include one series of hot dip coatings, approximately .001" of zinc, and they are exposed in each of the locations, but we can not give you any conclusions because no coatings of zinc .001" thick have failed anywhere, so that that answer has to be postponed.

MR. W. R. MEYER (General Electric Co., Bridgeport, Conn.): Dr. Blum, I believe you mentioned that it made no difference what type of nickel solution you deposited on your metal. Does the previous treatment of the specimen, whether you use a straight acid dip on steel, or an electrolytic pickle, for instance, make any difference on the corrosion resistance of those electro-plated articles?

DR. BLUM: We did not include a great variety of preliminary

treatments. We used one set of conditions which we called standard, which involved the ordinary acid dip pickle, electrolytic cleaning and acid pickle, and then we included in one set cathode pickling, and in another one anode pickling. That was the only variation we had in the conditions prior to plating.

So far as the actual protection against corrosion is concerned, we could not find any material difference in those three sets, but we did find that the small blisters which tend to form on the long exposure, especially on the specimens that are chromium plated, were more likely to form on those cathodically pickled, or just pickled by immersion, so that if we were to take those tests we would say that whatever tendency there is for small blisters to form is greater on steel that is cathodically pickled. That is perhaps the only conclusion that we could reach from those three series.

MR. MEYER: I would just like to add a few words on this cathodic pickling. Very recently there has been an exceedingly interesting article published in Germany on the effect of hydrogen on the embrittlement of steel. These experiments were done on steel under tension, and they varied the tension of the steel, but the very exceedingly interesting part about it is that in pure sulphuric acid (for instance, they used a 5% sulphuric acid bath) there was no embrittlement of the steel; but only when sulphur was present, or arsenic, did you get pronounced embrittlement. The effect of the concentrate of sulphuric acid was practically nil. There was very little difference between a 5% or a 40% solution, but those effects of the impurities on the embrittlement were so pronounced that I think that may lead to an answer to some of the difficulties that we may have had in electrolytic pickling, such as embrittlement of springs.

They found, furthermore, that the tension to which the steel was subjected had a bearing on the embrittlement of the steel. That might tie up with the co-working of the steel previous to deposition.

MR. STRAUSSER: May I ask the speaker whether that was on low or high carbon steel?

MR. MEYER: I believe it was on low carbon steel. I would recommend that paper to anyone who cares to read it. I have the German copy here if anyone wants to see it.

DR. BLUM: I recall the abstract of the article, and noted it with some interest. I am not in position to comment on it, because while we used pure acids in all of our work, there, of course, the term "pure" may mean much or little. I mean, we did not test for traces of arsenic or other elements.

I am going to take this time to call attention to something which was referred to in general terms by Mr. Strausser, which illustrates the fact that sometimes the results in this field may

be affected by conditions or materials that are very difficult to control or determine.

You will recall that last year we described a method of stripping nickel from steel by reversed current in a strong sodium nitrate solution. Mr. Brenner had to discontinue that work on the first of July. Fortunately for him we were able to keep him in the work of the Bureau, but in other work, out in California—in cement work—so that we were unable to continue that activity. But Mr. Strausser had confirmed it a number of times, stripping nickel from steel, and it gave such beautiful results (no loss in weight of the steel and a fine, clean surface) that we felt it was the very thing for platers to use, both for analysis and for restripping.

About six weeks ago we happened to have a meeting of our group, talking over the results of these tests, and I made the remark (this was in the morning) that although we reported about a year ago on that sodium nitrate stripping test we had never heard whether anybody had ever tried it and whether it worked or not, and I said, "That's the trouble with doing work and reporting it. If people don't try it and report the results that they get, you are never able to tell whether the method is satisfactory or not." I was inclined to be critical.

That afternoon, in the mail, I got a letter (my prayers were being answered very quickly) from a company stating that they had used the method and that most of the time it gave them very satisfactory results, but that every once in a while they got the steel badly attacked. We asked them to send us a sample of the sodium nitrate that they were using, and Mr. Strausser also made some more tests, just to confirm them, to see if we had overlooked anything and, taking two bottles of chemically pure sodium nitrate, when Mr. Strausser made the tests in one he found that there was no attack of steel, and when he made the test with the other he found the steel was attacked.

We had both samples analyzed, not only chemically but spectroscopically, and we could not find any difference between them. This has all occurred within the last week or ten days. I can not tell you the answer, because then, after we had been working on it, we sometimes got the steel attacked in the sample that at first did not attack the steel, which indicated that it was not the composition of the sodium nitrate, but some little kink in the procedure.

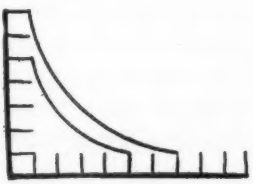
We are dealing there with the passivity of a metal. We have two metals, nickel and steel. We want to make the nickel active and the steel passive, and most of the time it works. All I have to say to you at this time is that some of the time it does not work, and we do not know why it does not work. We are not going to be satisfied until we find out, and of course if we find out we hope to be able to tell you what precautions to take to make sure it works one hundred per cent of the time.

I am telling you that without any apology because it illustrates the fact that no matter how careful and thorough your research work may be, there is always a possibility of some element or factor coming in which upsets your conclusions, and I console myself by saying that that is what nature does, once in a while, just to keep us from getting a swelled head and thinking we know everything about it. Just when we think we have worked out something beautifully, nature comes along and shows us it is not quite so beautiful after all. It is all in line with what was said about this effect of pickling, because traces of impurities may cause it.

MR. MEYER: I would like to say that I was one of the persons who wrote you on the question of using sodium nitrate as a stripping agent, and there is a paper to be presented at the September meeting of the Electrochemical Society that seems to have a little bearing on this problem here. I tried that sodium nitrate bath for stripping nickel coatings. I ran into the same difficulty. I had an attack of the iron, and we were unable to use it. The attack seemed to be as bad as with our own method of stripping in the sulphuric bath.

(At blackboard) There is a paper to be presented on the passivity of nickel and steel, and, I believe, cobalt and nickel and chrome steels, in the Electrochemical Society publication in the fall, and the author brings out the fact that nickel is more easily passivated than iron, and, from those curves (indicating) it seems that it will be difficult to get the theoretical effect that we want to passivate the iron and not passivate the nickel.

He uses various values of nitric acid. One curve is like this, and the other curve is always just above it, and I believe that theoretically it seems rather difficult to reach that stage:



PRESIDENT VAN DERAU: There is one thing I would like to point out on the etching of steel with the sodium nitrate, that it may lie in your steel. We have had some experience in production where you will have a higher content of silicon. What I have in mind is steel that is something like body or fender stock. We bought this material from the steel plant in our town and, in putting it through a cleaning machine where there was approximately five pounds of borax to four hundred gallons of water any number of parts would come out completely covered with a light film of rust, and then the next few feet would come out nice and clean. Then you would again get some of that rusty shade to the steel.

We found that even with that small amount of alkalinity silicon would very readily dissolve in any alkaline solution.

Another thing, in the making of steel we have also found, particularly in iron covers, that occasionally we will get a shipment and, under heating of the iron, we will have a few blisters develop. Now, in no case has it ever been one hundred per cent of the lot. It may be ten out of a thousand or one hundred out of a thousand, although it would be very abnormal to have that many. You might go along for two or three months without having any of it.

One of the practices in a steel plant is to use aluminum to de-gassify their billets, and if you go to a steel plant and see them pour their steel, after they have poured the billet the operator will take a handful of aluminum pebs and drop it into the hot billet in order to force the gas to the top. That can be overdone. We make an analysis of the steel to try to get at the bottom of this blistering under heat and we found that the slightest change (I cannot quote the exact figures now, but it is a very small per cent) in the total composition of the steel will cause that blistering. It may be that your sodium nitrate is attacking a small amount of aluminum in small parts of steel put in there by the steel maker, or it may be due to a variation in the silicon. I believe you will find both silicon and aluminum to be readily attacked by sodium nitrate.

DR. BLUM: I might say that we have, in a previous publication, called attention to the fact that it is not good for high carbon steel. That much we anticipated. The experiments we have made later have been made with low carbon steel, presumably uniform, although I agree with you that you can never be sure that if you cut two pieces of steel off the same strip they will be uniform what you say is very true. Thank you.

PRESIDENT VAN DERAU: There is another phase to that. When they crop these billets they may not crop back as far on one as on another, and in that way, as a rule, you will find that same steel will have plenty of pips and pits rolled in in the rolling process, which generally indicates short cropping on the billet itself, in which they fail to get out the gassy section.

DR. BLUM: Mr. Fraine, have you any comments to make on the sodium nitrate strip?

DELEGATE WALTER FRAINE (Dayton Branch): Only to confirm what you have already said. The National Cash Register was the firm that wrote to the Bureau in connection with this stripping process. We tried it out. We are developing, or have developed, a very high-quality chrome product.

Now, of course, all of these parts do not come through perfect. We have some loss, and when it comes to the question of the cost of refinishing these

parts the polishing cost is the big item. Anything that we could do to reduce that cost is something we are looking out for.

When we read about this nitrate of sodium strip we got into it to find out what we could do with it. We did find that in most cases it would do a most beautiful job of stripping both the nickel and copper on steel, and leave the surface so good that in ninety-nine per cent of the cases you could immediately turn that piece back and run it through again without repolishing and get a fine quality of work. However, we did find that in some cases corrosion took place very heavily.

We found this, too, that wherever we had an electrically-welded piece of work, wherever the welds were it would corrode, and from that point it would spread.

We also found that where we had seams in the work, where the two portions of steel were butted together and formed a joint, in many cases corrosion would set in at those points and eat out large cavities. This process looked so fine to us—it was so simple and worked so well in the aggregate—that we were anxious to know exactly what was taking place, and one of my assistants wrote to Mr. Blum telling him how we were using it and asking for information. We are here today particularly to find out what has been learned about that, because we can take that information back and use it.

On the whole, we got splendid results. In other cases we got just rotton results, and we are hoping to find a solution for it in some way.

DR. BLUM: I again just mention, in order to make the picture complete, that we had just recognized that any large content of chloride in the sodium nitrate was detrimental. Since then we checked up and found, however, that that has to be a half per cent or more. In the particular case Mr. Fraine speaks of they had only 2% of sodium chloride in there, and that could not account for the difficulty they experienced.

MR. B. H. MCGAR (Chase Brass & Copper Co., Waterbury, Conn.): What is the approximate composition, and what is the optimum temperature?

DR. BLUM: This is operated at nearly boiling temperature, from ninety to one hundred degrees Centigrade, and with a bath containing at least three pounds per gallon of sodium nitrate. Current density can be about 100 amperes per square foot. Most of the time it works, and we just do not know why it does not work all the time.

SECRETARY GILBERTSON: Have you noticed that on standing it becomes inactive? Years ago I had occasion to use it and at that time I found that where we were running work that only required this dip occasionally the next time I wanted to use it I found I could not. It did not work.

DR. BLUM: We have not had that experience, perhaps because we have not operated any particular bath long enough to find that out, because of course, most of ours has been on a small scale, although Mr. Brenner did, for a period of a month or more have a bath made up in a five-gallon galvanized bucket and used it there for a month stripping anything he could lay his hands on. He could not make a thing come out badly. It is just since he left that this trouble has developed.

SECRETARY GILBERTSON: In the meantime, had that dip stood still for some time?

DR. BLUM: It might have stood still for a week. In these later cases it was a solution freshly prepared.

SECRETARY GILBERTSON: I think that has something to do with it.

DELEGATE HANLON: In your experience with this dip has the operation always been in the same kind of container, whether you had your success or whether you had a failure?

DR. BLUM: Yes. Of course, in our laboratories we ordinarily make this up in glass jars or beakers, and in that case we get these erratic results too.

MR. CLEVELAND F. NIXON (Ternstedt Mfg. Co., Detroit, Mich.): Talking about the sodium nitrate strip, you may be interested to know that about a week after the convention last year we started to use it and we have been using it ever since, up into several thousand gallons. I gather from what I can hear back here that the trouble encountered is irregular, but severe corrosion localized, which might actually perforate the piece.

That is exactly what we have found on a small percentage of pieces. It is interesting to note that we got busy a while ago. We started to operate the strip continuously, day and night, and instead of getting worse it got better. Also, we started off using anodes with the tank insulated, and the tank did not last more than a month or two, so we took the cathodes out and made the tank cathode, and then did not have a bit of trouble from that score.

The tank, when neutral, had a heavy shell on the inside of it, until finally the tank perforated and we had to put a new one in.

DR. BLUM: These experiences are very, very valuable, and if you will forgive a little story, the fact that we get this advice and information is going to prevent us from being in the position of the old farmer, you know, who asked his friend for advice. He said his horse had epizootic, and wanted to know what his friend had given his horse. His friend said "Turpentine."

The next day he met his friend and said, "Well, I gave my horse turpentine, and he died."

His friend said, "So did mine."

MR. F. D. PACE (J. C. Miller Co., Grand Rapids, Mich.): Did you ever use sodium nitrite instead of nitrate?

DR. BLUM: We know that when you use the nitrate for a while you get nitrite formed in it, and we made the precaution that if you add acid to keep the thing nearly neutral be sure to have it well ventilated, because the nitrite gives off these oxides of nitrogen.

PRESIDENT VAN DERAU: The commercial product that we use is generally made up of a mixture of potassium nitrate and sodium nitrate. You can take the melting temperature of that, for heat treating purposes, and get anything you want from 400° up before you finally reach the boiling temperature of that material.

We have had applications, in making thermostats, in which, in dealing with bi-metals, we are using potassium nitrate, and sodium nitrate will not give us quite a low enough melting temperature. We find that by using the nitrate we get a much lower temperature. In fact, we can go down to 275 degrees, using fifty per cent potassium nitrate and fifty per cent sodium nitrate, as against four hundred degrees for the sodium nitrate and potassium nitrate.

One of the things noticeable is that the discs, with the nitrite solution, are

much cleaner than with the nitrate, and I wonder if it is possible that the nitrites would produce better results than using nitrates.

DR. BLUM: That would be worth trying.

Are there any further questions on these exposure tests or on any of the other things reported so far?

MR. WILLIAM J. ERSKINE (Keeler Brass Co., Grand Rapids, Mich.): On this nitrate strip that we have been speaking of, I wonder if there is anything that will stand a spring action for a clip. We have a top cap that goes on these stoves as a gas cock, and we have tried the spring steel that you have spoken of, and have found that the clip will stand only about one-half hour of the strip or, at best, two hours.

DR. BLUM: That confirms just what we predicted. High carbon steel is attacked. We know that.

MR. ERSKINE: Have you any suggestion as to what might be used in place of it to get a spring contact?

DR. BLUM: You might be able to work out a scheme with a low carbon hook, or something like that. You can not get a spring.

MR. ERSKINE: The piece, of course, is not suitable to use a hook or wire contact.

DR. BLUM: I am sorry; I can not help you.

Mr. Thompson just reminds me that there has been no comment on the proposed program for research on the non-ferrous metals. Are there any comments on that program?

PRESIDENT VAN DERAU: There have been some new developents since this morning on this research problem, and I am going to request that all the Past Presidents, the Executive Board, and any members of the Research Committee who are present get together this evening for possibly half an hour, and we may have a further announcement to make later in the session.

SECRETARY GILBERTSON: So far as you have gone in this part of the program, which you say will run over a period of two years, what would be the total expense. Have you made any kind of budget as to what the amount of money is that is necessary to carry this thing through. Could you give us any idea of that?

DR. BLUM: Yes. I did not previously mention it, thinking it would come up in the business session. If it is appropriate to mention it here to give you something to think about, in order to provide the salary of a Research Associate, sufficient funds for travel (and, remember, that involves travel that must be made for inspections at fairly frequent intervals) and the special materials that are required—anodes, chemicals, and so forth—we figure that there should be about $5,000 a year available for two years.

Now, it is true that part of that might be given in the form of materials. If a manufacturer gives $100 worth of nickel anodes, it is the same as if he makes a subscription of $100, so that in fixing on an approximate figure of $5,000 per year for two years we feel that that is as close as we can approximate it in advance of the exact program.

CHAIRMAN THOMPSON: Delegates, you will have no excuse, when we go into the business session and endeavor to determine the fate of future research work, for not obtaining the picture as Dr. Blum is now prepared to give it to you, if you will only ask questions.

Hearing no other questions, we will proceed to the next paper, by Mr. M. R. Thompson, of the Bureau of Standards. This paper will be read by Dr. Blum.

DR. BLUM: Along with the curtailments in money for salaries, of course we are also limited in our money for travel, so I regret very greatly that it is not possible for Mr. Thompson to be present here to present this paper in person, and also to get the contact and association with the other members.

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SOME NEW DEVELOPMENTS IN BUFFING COMPOSITIONS

By G. M. Cunningham

Read at Detroit Convention 1934

THE operation of buffing consists in the removal of scratches, die marks, and other light imperfections from the surface of metals and other materials, prior to the final finishing operations of plating, lacquering, or coating with some other compound. The mechanical process of buffing consists in the application of a bar of buffing compound containing suitable abrasives to a revolving buffing wheel, whereby the periphery of the wheel is coated with the compound.

This step is followed by the application of the work surface to the coated wheel periphery whereby the surface irregularities are ground out, and as high a lustre as possible is produced in order to give a satisfactory uniform high finish to the piece. Just as in painting, it is axiomatic that the condition of the buffed surface governs the final plated finish; that is, the more perfect the surface finish of the base metal, the more perfect is the final surface plate.

The conditioning of the object surface by buffing is usually a two-wheel operation performed without the intermediate steps of cleaning. The first operation is in "cutting down," to remove as many major surface marks as possible, to level all hills, to remove corrosive residues from prior operations, and to scour away all stains. Perhaps 90% of the total surface removal during buffing occurs in this first operation. The second operation of "coloring" is performed for final high lustre finish, to remove any minute scratch marks caused by the cutting compound, and to condition the surface for final plating.

The ingredients of the cutting or coloring compounds are the materials which actually condition the surface in buffing, since the wheel is merely the carrier of the composition. Buffing compounds contain mild abrasives and bonding materials, usually fats or greases.

Up to several years ago the composition of cutting compounds was fairly definitely fixed, but with the advent of the demand for scratch brush finish work, the composition of the binders has been changed considerably. However, the average cutting compound used today for general work prior to coloring for high lustre is composed of a mixture of abrasives such as tripoli, and a

binder usually composed of tallow, double pressed stearic acid, rosin, and petrolatum.

The function of stearic acid in the binder is to give hardness and high melting point to the composition, and to prevent softening and excessive feed onto the wheel under conditions of high temperature, high speeds, or severe cutting demands.

The inclusion of rosin in a binder composition is to enable the cutting compound to adhere to the buff wheel periphery and not be thrown off by centrifugal force built up by high speeds. Stearic acid also helps increase the quality of adhesiveness. Rosin acts as a binder and plasticizer in buffing compounds, thereby cementing together the individual grains of abrasive to yield increased mechanical strength and uniformity of composition of the bar during manufacture.

Petrolatum and tallow act chiefly as lubricants in binders for buffing compositions. Tallow seems to be used not only for its lubricating ability, but as an aid in imparting increased hardness to the bar, and because of its ability to be saponified by alkalis, to produce water-soluble soaps, thereby aiding the subsequent clean-up operation. The necessity for suitable lubricant properties of a buffing compound both in applying the bar to the wheel, and more particularly in lubricating the work during cutting or coloring, is essential.

Absence of sufficient lubrication in a buffing compound causes the wheel to burn and the work to suffer through excessive heat. An analogy may be drawn between the lubricant in the form of a cutting oil necessary in turning or drilling, and the lubricant in the form of petrolatum and tallow in a buffing composition. In both cases, metal is being removed, work is being performed, and a lubricant is necessary to reduce friction and excessive heat development.

By varying the amounts of binder constituents in a buffing compound, various types of bars having different physical properties are possible. Higher amounts of stearic acid and high melting point fats produce hard, high melting point compositions for buffing at high speeds. Other consistencies are made by incorporating smaller amounts of stearic acid, using softer fats, and increased amounts of petrolatum for buffing at medium or slow speeds. Each composition operates at optimum efficiency under the particular conditions of metal composition, shape of piece, type of buff, speed of wheel, etc., for which it is designed.

The ideal cutting compound for both hand and automatic machine buffing must possess the following characteristics, so far as the actual cutting down is concerned:

1. The composition must cut down all surface irregularities without itself leaving surface markings unable to be quickly removed in the following coloring operation.
2. The consistency of the compound must prevent the material from melting too rapidly at the temperature of buffing, causing excessive compound consumption. Nor must the bar soften appreciably in storage in summer weather, causing distortion of the bar form in which it is cast. On the other hand, the compound must not be so hard and possess such a high melting point that little or no feed to the wheel occurs without excessive pressures which may cause wheel burning.
3. The compound must possess sufficient lubricating properties to prevent undue rise in temperature due to excessive friction developed. Incidentally, the burning of work and wheel under high speed operations required in continuous commercial production has been a problem of major importance. However, advances in buff wheel design and construction along the lines of air cooling through pocket and bellows type have helped to solve this problem.
4. The buffing compound must contain sufficient adhesiveness to make it stick to the wheel periphery after dressing, and not be thrown off by centrifugal force.
5. The buffing bar must be of such a constitution as to prevent the buff wheel from being glazed over by continuous application of bar or work to the wheel, giving too slick a surface a poor biting or abrading qualities to the cutting face. This is often caused by too much lubricant and not enough abrasive in the compound.
6. The mechanical strength of the buffing compound as cast in bar form for ease in application must be sufficient to withstand incidental shocks in transportation and the heavy pounding occurring in hand or automatic machine buffing. Any tendency toward brittleness must be eliminated.

The present buffing compositions now on the market possess most, if not all, of the above characteristics, and insofar as cutting

down and coloring is concerned, they do a satisfactory job. However, in the subsequent clean-up, preparatory to final plating or lacquering, the average commercial product may be improved upon considerably.

When analyzed in a strictly chemical sense, the binders of most commercial buffing compositions are saponifiable in alkaline cleaners, where the fatty acid ingredients of tallow, rosin and stearic acid combine chemically with the alkali of the cleaning solution to form water soluble or emulsifiable soaps of the corresponding fatty acids. Hence, two steps (1) Saponification, and (2) Emulsification must occur before the binder is freed from the buffed surface. Such unsaponifiable ingredients as the abrasive must be removed from the buffed surface by emulsification, either in the soap soak, or alkali cleaner. The usual cleaning cycle in the average commercial plant using the conventional buffing compound on *brass* is generally:

1. Whale oil soap soak, employing a bath at nearly boiling temperature containing 4 to 8 ounces of 65-75% soap content per gallon of water, depending on the amount of material to be removed from the work surface and the percentage of unsaponifiable material in the buffing composition. A good many whale oil soaps are furnished with an excess of free alkali to insure complete saponification of the soap during manufacture.
2. Hot water rinse.
3. Alkali cleaning bath to saponify all ingredients possible, and to hasten emulsification of all work surface dirt.
4. Cold water rinse.
5. Cyanide dip, employing 3 to 5 ounces of sodium cyanide per gallon of water.
6. One or more cold water rinses.

It has been found through long experience that the above clean-up cycle is satisfactory for most simple plane surfaced work, buffed with a saponifiable compound, and although it is time consuming, the work is generally clean. However, where the shop is faced with work containing deep recesses, etches, holes, and corners, the problem of cleaning out the imbedded saponifiable buffing compound is greatly amplified. Fear of excessive alkali tarnish when employing stronger cleaners to remove this deeply imbedded dirt has forced many a plant to the

laborious, slow operations of hand cleaning with brush, rag or stick, thereby slowing production considerably.

The conventional buffing composition made with a saponifiable binder such as tallow is also open to the objection of corrosion of the buffed metal surface if the work is held up any considerable time between the buffing and clean-up operations. Commercial tallow which is incorporated in the average buffing compound to give lubrication, develops free fatty acids with age and with the high temperatures of buffing.

Being in nearly absolute chemical contact with the bare metal surface being buffed, a chemical combination between metal and fatty acid to form the corresponding metallic soap plus the equivalent in corrosion often takes place. This corrosive effect is generally proportional to the length of time between buffing and clean-up. Very few shops are proof against delays between these two operations, such as over week-ends, and hence the problem of fatty acid corrosion is nearly always present.

In view of the above recognized objections to the present buffing compound made with saponifiable binders, work was undertaken to develop a series of cutting and coloring compounds which, while possessing all the necessary qualities for conditioning the work surface, could be readily removed from the piece in the following clean-up operation, in the simplest, easiest and fastest way possible. The work was governed by the desire to increase production speed by producing a buffing compound 100% emulsifiable, thereby eliminating several steps in the clean-up operation. Our investigations were helped through our long experience in producing water-emulsifiable animal, vegetable and mineral products for a number of years.

The final correct combination of 100% water emulsifiable binder ingredients and abrasives is shown by the sample bar of cutting compound. This composition contains no ingredient likely to contain or to develop free fatty acids on standing, hence the bugbear of corrosion has been eliminated. That the product is totally emulsifiable in hot water is shown in the sample bottle. A sample of the conventional saponifiable buffing compound which we attempted to emulsify in hot water in similar fashion to the above, is also shown. It is to be expected that the latter sample is very nearly waterproof when it is considered that its binder is composed of rosin, tallow, stearic acid and petrolatum—all being insoluble in hot water.

It has been determined by the various brass companies cooperating with us in developing this new 100% water-emulsifiable buffing compound, that the clean-up operation on brass subsequent to buffing may be shortened by as much as half the time necessary with the saponifiable type of compound. The time consuming operation of soaking the work in whale oil soap solution is eliminated, as well as the danger of tarnish attending this operation, due to the presence of free alkali usually contained in excess in whale oil soap, to insure complete saponification in manufacture.

Because of the total emulsifiability of the binder in the composition, the need for strong alkali cleaning baths is eliminated. There seems to be no difficulty in complete removal of the compound packed in deep corners, cracks and holes by simple bath immersion, without the necessity for manual scrubbing in cleaning solutions. This is helped materially by the comparative absence of shredding and excessive feed of the compound on to the wheel, and to the work, even in hot weather operations. Cleanliness in use is one of the marked characteristics of this new compound.

The cycle of cleaning operations determined for this new emulsifiable buffing compound has been determined to be:

1. Hot water rinse employing circulating water as near boiling as possible. This rinse should be comparatively short. In this bath, practically all of the composition is removed from the work surface by emulsification.
2. Alkali cleaner bath, using roughly half the solid cleaner per gallon of water that is used in cleaning up the saponifiable binder type of buffing composition. The use of alkali cleaner in this instance is chiefly for removing by saponification the residues of drawing, stamping or cutting compounds used in operations prior to buffing.
3. Hot water rinse.
4. The conventional sodium cyanide dip. (Applause)

DELEGATE HERMANSEN: Have you that compound in liquid form, so that it can be used as such?

MR. CUNNINGHAM: No, we have not. Why do you want it in liquid form?

DELEGATE HERMANSEN: On automatic buffing machines it takes too much time to apply the compound. We cannot find it anywhere in the country. Nobody makes it.

MR. CUNNINGHAM: Would there be much demand for that if it were produced?

DELEGATE HERMANSEN: It seems to me there should be, because you consume a lot of time in applying the compound on all automatic buffing machines.

MR. MEYER: I would like to ask a question about the two bottles that you have there. Are they just shaken up with hot water, or have you an alkali in there?

MR. CUNNINGHAM: There is no alkali at all. That is a self-emulsifying compound.

MR. MEYER: A good many of those compounds seem to emulsify beautifully in the cake, but when you use a wheel at any speed at all they do not emulsify as they did in the original cake.

Have you done work with that type of compound, and found that the compound actually emulsifies out of those crevices?

MR. CUNNINGHAM: We have in one plant for about six weeks, so far. This is still in the experimental stage, because we have not got into production except for brass. On ferrous metals we have not done anything so far.

MR. MEYER: There is just one other question. You mentioned that tallow, on standing, tends to develop free fatty acid. My conception of tallow is that it develops, on standing, either stearic or oleic acid, or acids of that type. In most of those compounds you add stearic acid any way, which contains oleic acid, and I wonder whether the interpretation would be exactly correct, that the staining is due to the acid developed from the tallow. I should believe it would be due to the acid added as stearic or as oleic.

MR. CUNNINGHAM: Yes, but you might say that stearic acid at room temperature, on the metal, prior to cleaning, is comparatively weak in effect. Stearic acid, itself, at room temperature, as you know, is practically solid. The acidity so far as corrosion is concerned is practically negligible. But Oleic acid and some of these other free fatty acids does have a considerably greater effect on non-ferrous metals.

MR. MEYER: But the stearic acid you use contains from ten to fifteen per cent oleic acid.

MR. CUNNINGHAM: Yes. The average buffing composition contains double pressed stearic acid to give it increased hardness and higher melting point, because a single pressed stearic acid has a lower melting point and is softer.

MR. KUTZEN: Will the speaker kindly explain the reaction that would form in the electrolytic cleaning bath for cleaning material buffed with that particular material?

MR. CUNNINGHAM: Ninety per cent of the removal takes place, not in the electrolytic cleaning bath, but in a hot water rinse. It would be clean enough for plating, free of tarnish, so far as we know.

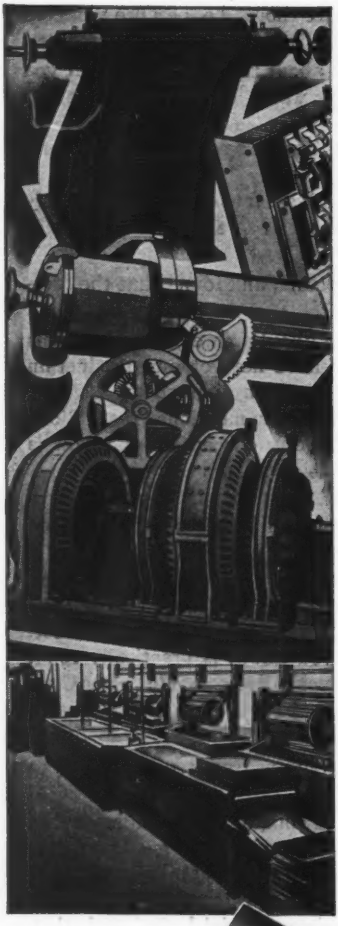
MR. KUTZEN: Have you any data on the life of a bath? How long could you use a cleaning bath?

MR. CUNNINGHAM: We have nothing on that so far.

MR. KUTZEN: Have you any data on any commercial work done with this material?

MR. CUNNINGHAM: Not on ferrous metals.

After all, this is an experimental proposition. There has been a demand. We knew that the demand had existed for a long time for a material such as this. This is our first attempt, and, as I said, in non-ferrous metal work it



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has been successful following the cleaning operations that we suggest, and we hope very shortly that we will have suitable compositions for ferrous metals.

MR. KUTZEN: Will that increase the cost of the buffing composition appreciably?

MR. CUNNINGHAM: It will not increase the cost appreciably. I will not claim how much of an increase there will be, if any. We have definitely found out—again on non-ferrous work—that it cuts the cleaning period in half, or approximately in half, eliminating the whale oil soap bath.

MR. KUTZEN: Could that material be used with the ordinary run of Tripoli? Could it be used with a material of that sort and still have the good effects of that emulsification?

MR. CUNNINGHAM: Not if you mean the actual powder. After all, this composition is complete in itself, and it would be useless, from our standpoint, to add it to the older type of saponifiable binder. We are trying to get away from that.

MR. MEYER: I do not want to unduly prolong the discussion, but I think we are all interested in this particular paper, because if this actually occurs, as the speaker says it does, I know I would like to get some of that material for our own use.

There is just one other problem that I have noticed. With some of these emulsifiable compounds the larger lump will emulsify, but you seem to have a very adherent film of buffing compound and dirt adhering to the work that does require a subsequent cleaning. I believe you said that you could go from your hot water to the plating bath, in answering one of the men.

MR. CUNNINGHAM: No; an alkali cleaner comes in between.

MR. MEYER: Is that fine film easily removed in that alkaline cleaner?

MR. CUNNINGHAM: In the six weeks' test, yes; but there will certainly be instances that we will come up against where this material will not be removed in our cleaning operation; and what it will do will be to make cleaning easier than with the saponifiable type of binder.

CHAIRMAN PHILLIPS: Are there any more questions, gentlemen?

MR. HOGABOOM: You gave the percentage composition of your buffing compound, as is. What is the difference between that and the percentage composition of the buffing compound after it has been applied to the wheel and the wheel and work have got hot, and the residue has been left on the work? Your results have been upon the emulsification of the material as is. What is that in relation to what is left in residue on the work?

MR. CUNNINGHAM: I did not give percentage compositions of these materials. I said, though, that for the six weeks' test period in actual operation the material was removed, with our cleaning cycle, satisfactorily. Now, whether the actual chemical composition of the compound on the work after buffing remains the same as in the stick before buffing, I do not know. We did not analyze it, but it is satisfactory so far as cleaning is concerned, which is all we care about.

CHAIRMAN PHILLIPS: Mr. Van Derau will introduce the next speaker.

MR. VAN DERAU: For several years there has been a great deal of question raised on the part of manufacturers as to what the true cost of plated ware is. One of the factors that seems to be evasive is the question of how to charge—what should be charged to overhead, and what goes to make up overhead,

what should be charged to the materials in such a way that you are able to obtain true costs.

About six months ago Dr. Blum had an inquiry from the National Association of Accountants. He referred them to me, to give them cost figures on what plated materials cost. I bring that up to show that there is a desire on the part of the manufacturing industries to know what true plating costs are.

A few weeks ago Mr. Oleson, who you know is in a jobbing business in connection with the activity of the Master Electro-Platers' Institute in trying to standardize prices in their industry, appointed a committee to work out ways and means to charge, as nearly as possible, uniform overheads, so that they can exchange cost information and know whether they are making or losing money, and what part of the business is causing the loss or the profit.

After I had exchanged several letters with Mr. Oleson and asked him whether he thought it would be desirable to have an accounting paper at his meeting he said "Yes". Then I got mixed up in my dates. I thought this Master Electro-Platers' Institute was going to parallel the Electro-Platers' Society meeting, and instead I found, on arrival, that that meeting had been held prior to this meeting. I asked our Works Accountant to prepare a short paper, and we will have him give you a short talk on accounting methods that have been proved over the last seven or eight years to give us accurate costs on plating labor, overhead, and the materials that enter into plating processes.

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The Abstract Section

EDWARD B. SANIGAR

THESE abstracts are mostly adapted, by permission, from "Chemical Abstracts", the references to that publication being given in the form — *C. A.*, **27**, 3402 (1933) *i. e.*, Chemical Abstracts, Volume 27, column 3402 in the year 1933. The name appearing at the end of the abstract is that of the abstractor. Abbreviations for scientific journals are those used by "Chemical Abstracts" (see *C. A.*, **25**, 6019 (1931). E. B. S.

Electrochemical properties of smooth electrolytically deposited metals of the platinum group. I. I. ZHUKOV. *J. Gen. Chem.* (U.S.S.R.) **3**,958 (1933).—Electrodes were prepared by depositing electrolytically on platinum first a thin layer of gold and then a thin smooth layer of platinum, iridium, rhodium or palladium. With these electrodes, equilibrium in potential measurements is obtained much more quickly than with platinum electrodes covered with platinum black. Detailed instructions are given for the preparation of such electrodes.

C. A. **28**, 3666 (1934). S. L. MADORSKY.

Electrodeposition of silver from organic solvents. Russian patent No. 33,135. November 30, 1933. I. A. SHEK, V. A. PLOTNIKOV and Z. A. YANKELEVICH.—The deposition is carried out in a solution of aluminum bromide and silver bromide in aromatic or brominated hydrocarbons, such as C_6H_6 and $(CH_2Br)_2$. *C. A.* **28**, 3313 (1934).

Differentiation between mechanical and galvanic gold-plating. E. RAUB. *Metallwaren-Ind. u. Galvano-Tech.* **32**,115 (1934); cf. *C. A.* **24**,1329 (1930).—Test pieces are cut from the object, coated heavily with copper, then polished and etched with concentrated nitric acid. Under the microscope, rolled plate shows little gold at the edges and over-soldered points. Galvanic plate has a uniform thickness on these places, because of plating after shaping. Rolled plate on pressed ornaments is uniformly thick; galvanic plate is not, because of the varying current density over an irregular object.

C. A. **28**, 3309 (1934). CURTIS L. WILSON.

A study of chrome plating. J. GLAYMANN. *Science et ind.* **17**, 278, 321 (1933).—A review of the theoretical principles and present-day technique of Chromium-plating. *C. A.* **28**, 3309 (1934). A PAPINEAU-COUTURE.

Chromium-plating. C. CAMPBELL. *Automobile Engr.* **22**, 462 (1932); *Met. Abstracts* (in *Metals & Alloys*) **4**, 286.—Review of recent developments.

C. A. **28**, 3309 (1934). G. G.

Chromium plating. U. S. patent No. 1,953,484. April 3, 1934. C. V. IREDELL (to Westinghouse Lamp Co.).—A non-flaking chromium plating on a wire is obtained by use of a solution formed with chromic acid 25 and sulfuric acid 2.5 to 4.5% and electrolysing the solution for only a limited time, substantially no longer than required to deposit approximately 3-4% of the

original chromium content of the solution, the temperature of the solution being maintained at about 20-30° C. and the cathode c.d. being maintained between about 8.5 amp. and 33.0 amp./sq.in. Apparatus is described.

C. A. **28,** 3671 (1934).

Electrodeposition of chromium. U. S. patent No. 1,952,793. March 27, 1934. D. T. EWING.—An electrolyte for chromium deposition comprises a solution containing chromic acid as the principal ingredient, a relatively small amount of a salt, such as cerium oxalate, and a relatively small amount of a soluble persulfate, such as that of sodium, which serves to prevent brownish coloration of the deposit. *C. A.* **28,** 3312 (1934).

Improved apparatus for chromium and silver plating. MANGOLD. *Tech. Blätter deut. Bergwerksztg.* **23,** 9 (Jan. 1, 1933); *Met. Abstracts* (in *Metals & Alloys*) **4,** 316.—Langbein-Pfanhauser apparatus for chromium plating makes possible chromium plating of certain articles which has hitherto been impossible. *C. A.* **28,** 3666 (1934). G.G.

Chromium-plating over nickel. JOACHIM KORPIUN, ERNST VOGEL and KARL SCHNEIDER. *Naturwissenschaften* **22,** 135 (1934).—Differences between nickel films as to plating qualities are not due to difference in hydrogen content of the nickel as found by direct micro-hydrogen determination (0.015-0.021% by weight). A difference in diffusion rate for electrolytic hydrogen for various nickel species exists, however. For 250 m.a./sq.cm. (228 amp./sq.ft.) and 2 *N* sulfuric acid as electrolyte, the diffusion rate varies from 0.05 to 0.9 cc. per hour per sq.cm. cathode surface through a 0.025mm. (one one-thousandth of an inch) nickel film. Nickel plates with high diffusion constants are more likely to loosen up than those of low constants. The constant is higher for small crystal grain size. The loosening of the nickel during chromium plating is brought about by the building up of hydrogen pressure below the nickel layer; it is less noticeable for basis metals (like iron) which are somewhat porous to hydrogen. The prevailing hydrogen pressure is more than 3 kg. per sq.cm. *C. A.* **28,** 3666 (1934).

Gas content of electrolytic zinc. W. BURMEISTER and M. SCHLÖTTER. *Metallwirtschaft* **13,** 115 (1934).—During the electrolysis of zinc in acid solutions, zinc and hydrogen are formed simultaneously at the cathode. The hydrogen content of zinc from solutions of 10^{-5} to 0.5 *N* acidity decreases with increase in current density. This is explained by the course of the current density-potential curves of zinc deposition and of hydrogen formation on zinc. Zinc deposits with minimum hydrogen content are obtained from still electrolytes. Agitation increases the hydrogen absorption. With constant c.d. the hydrogen content increases as the acidity of the electrolyte is increased. The hydrogen content does not decrease after storing for several weeks at room temperature. When zinc is distilled in an atmosphere of hydrogen at 0.01mm. mercury pressure, it absorbs considerable hydrogen during condensation. Under higher pressure very little or no hydrogen is absorbed. *C. A.* **28,** 3307 (1934).

The throwing power of zinc-plating solutions. II. The relation between current density and cathodic polarisation potential of zinc sulfate solutions. MASAMI NAKAJIMA. *J. Electrochem. Assoc.* (Japan) **2,** 72 (1934); see Monthly Review **20,** No. 10, 40 (June, 1934).—The relation between current density and cathodic polarisation potential has been worked

out with 0.5 to 2.5 *N* zinc sulfate solution (pH 3.4 to 1.6). The polarisation potential is raised with an increase in current density and is lowered by an increase in zinc sulfate concentration. In a zinc sulfate solution of the same concentration, this potential tends to be increased with a decrease in pH value, and the lowest potential has been obtained in 0.5 and 1.5 *N* solution with pH 2.8, and in 2.5 *N* solution with pH 3.4 at lower current density and with pH 2.2 at higher current density. Change in pH does not greatly affect the polarisation; the greatest effect is observed in 0.5 *N* concentration; it decreases with an increasing zinc sulfate concentration. *C. A.* **28,** 3307 (1934).

Anodic coating of zinc-base metals. U. S. patent No. 1,953,997. April 10, 1934. E. C. TRUESDALE and E. J. WILHELM (to New Jersey Zinc Co.).—Metal articles such as those of zinc or zinc alloys are provided with a dark-colored, thin, dense and firmly adherent anodic coating composed essentially of zinc oxide and which is deposited from an electrolyte containing sodium hydroxide and barium hydroxide. U. S. patent No. 1,953,998 relates to a generally similar coating of lighter color comprising zinc oxide and which is formed by use of a sodium carbonate solution or sodium hydroxide and ammonium hydroxide. U. S. patent No. 1,953,999 (E. C. Truesdale, E. J. Wilhelm and C. E. Reinhard (to New Jersey Zinc Co.)) relates to coatings containing an insoluble compound such as results from use of potassium permanganate in addition to, or in substitution for, zinc oxide. U. S. patent No. 1,954,000 (E. C. Truesdale and E. J. Wilhelm (to N. J. Zinc Co.)) relates to coatings containing a compound of an amphoteric metal other than zinc, such as one containing aluminum, tin or chromium. *C. A.* **28,** 3672 (1934).

A new bath for the direct nickeling of zinc. GEO. W. NICHOLS. *Trans Electrochem. Soc.* **64,** 265 (1933).—Displacement of nickel from its solutions by zinc is retarded by salts of hydroxy acids, alcohols and dextrose. *Lactates* are especially effective in retarding deposition by immersion. Good deposits of nickel on zinc may be obtained from solutions containing lactates. The yellow tone of deposits from citrate-bearing baths is not met with. The best deposits are obtained at a pH between 3.7 and 4.3. More acid baths increase the possibility of streaking; more basic baths decrease the adhesion. Highly acid or ammoniacal baths may be buffered to the optimum pH by the addition of excessive amounts of ammonium lactate, but the plating characteristics of such baths are not altered by the buffering. The ratio of lactate to nickel in the baths must be increased as the concentration of nickel is increased. *C. A.* **28,** 3308 (1934). C. G. FINK.

The effect of chromium in nickel-plating baths. F. PIETRAFESA. *Atti IV congr, na°. chim. para appl.* 1933, 776; cf. Macnaughtan and Hammond, *C. A.* **24,** 5641 (1930).—A small quantity of chromic acid (CrO_3) in a nickel-plating bath lowers the cathode efficiency appreciably. A bath containing crystalline nickel sulfate ($NiSO_4.7H_2O$) 50g., ammonium chloride 25g./liter and 5-10 mg./l. of chromium as chromic acid is practically useless because of low efficiency and poor nickel deposit. Addition of chromic sulfate ($Cr(SO_4)_3$) is less injurious. The cause is probably diminution of hydrogen over-voltage by formation of chromium chromate, $Cr_2O_3.CrO_3$ and chromic hydroxide, $Cr(O)_3$, which in a colloidal state are deposited by cataphoresis on the cathode. Nickel baths containing chromium can be regenerated by prolonged electrolysis. *C. A.* **28,** 3666 (1934).

Most common defects shown by electrodeposits of nickel. O. MACCHIA. *Industria chimica* **8**, 571 (1933).—The causes of various types of defects shown by nickel electrodeposits, and the methods of treating the plating bath to eliminate such defects, are summarised.

C. A. **28**, 3308 (1934). B. C. A.

Coloring copper and its alloys brown. H. KRAUSE. *Mitt. Forschungsinst. Probieramt Edelemetalle* **7**, 141 (1934).—Solutions of copper sulfate, copper acetate, potassium aluminum sulfate, ammonium chloride, ammonium sulfate, ammonium acetate, sodium acetate, sodium oxalate and sodium tartrate were investigated with regard to their intensity in coloring copper and copper alloys brown. Only a few gave satisfactory results; 50-60g. copper sulfate in one liter of water is recommended. In general, these solutions can be used in place of the usual permanganate and chlorate only when olive-brown or olive-green tints are desired, or reddish tints on tin bronze.

C. A. **28**, 3364 (1934). M. HARTENHEIM.

Rapid development of patina on copper after installation. J. R. FREEMAN, Jr. and P. H. KIRBY. *Metals & Alloys* **5**, 67 (1934).—A method is described whereby copper roofs may be given a "natural" patina by a simple spraying treatment. Preparation of the solution and method of application are given in detail. *C. A.* **28**, 3700 (1934). DOWNS SCHAAF.

Aluminum. Russian patent No. 28,481. June 30, 1933. A. A. KHAKIN.—In the electrodeposition of aluminum from salt solutions solvents are used which are not decomposed by the liberated ions. For example, in the cathode compartment, separated from the anode by a porous diaphragm there is used a solution of an aluminum salt in glycerol, acetone, etc., and in the anode compartment a solution of an anodic product in water or another liquid which is not decomposed by the liberated anions.

C. A. **28**, 3313 (1934).

Electroplating. (Preparation of aluminum for electroplating). British patent No. 404,251. January 11, 1934. Addition to British patent No. 385,067 (*C. A.* **27**, 5257 (1933)). Siemens & Halske A.-G.—Aluminum (or aluminum alloy) is prepared for electroplating by anodic treatment in a bath containing phosphoric acid to form an oxide film which is then reduced in an alkaline bath, containing metallic compounds, with simultaneous deposition of metal, e.g., copper, brass, which forms a base for further electrodeposition.

C. A. **28**, 3672 (1934).

Electrodeposition of bismuth from perchloric acid solutions. M. HARBAUGH and F. C. MATHERS. *Trans. Electrochem. Soc.* **64**, 293 (1933).—The bath contains 4g./100cc. of bismuth oxide and 10.4g./100cc. of perchloric acid, together with 0.03% of glue and 0.08% of cresol. The bismuth perchlorate bath without an addition agent had a decomposition voltage of 1.62, a cathode efficiency of about 100% and a throwing power of 7-9%. The presence of small quantities of nitric acid or ammonium nitrate, or of large quantities of ammonium perchlorate had no appreciable effect on the deposits. Bismuth-plating on base metals seems unsatisfactory for ornamental or protective purposes, because it tarnishes and is soft and brittle. However, a use may be found for electrolytic bismuth in certain electrical or other physical devices. The perchlorate electrolyte may be used for the deposition of alloys

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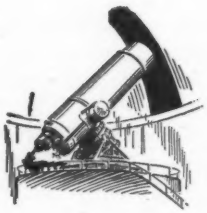

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of bismuth with copper, lead and arsenic. Perchlorate was found in the deposited bismuth along with the addition agent.

C. A. **28,** 3308 (1934). C. G. FINK.

Electrodeposition of tin. British patent No. 404,533. January 18, 1934. P. R. PINE (to the Harshaw Chemical Co.).—Tin is deposited from an acid bath containing tin sulfate and a soluble control agent prepared by reacting cresol, substantially free from ortho-cresol, with gelatin, aloin or an aldehyde, e. g. formaldehyde, and then sulfonating the product. Alternatively the cresol and the ge'atin, aloin or the aldehyde may be sulfonated before reaction. A soluble fluoride and a nickel salt are preferably added to the depositing bath. The anode may be of tin, and the tin may be deposited on zinc, aluminum, iron, steel and copper. *C. A.* **28,** 3671 (1934).

Electrophoresis of latex and its control. MAURICE DÉRIBÉRÉ. *Rev. gén. mat. plastiques* **9,** 685 (1933).—A brief explanation.

C. A. **28,** 3615 (1934). A. PAPINEAU-COUTURE.

Pickling ferrous metals. U. S. patent No. 1,954,743. April 10, 1934. O. L. PETERSON, H. L. PETERSON and C. E. PETERSON (to Delaney Chemical Co.).—A mixture comprising copper sulfate, aluminum acetate and sodium chloride is used. U. S. patent No. 1,954,744 relates to the use together of oxalic acid, a copper salt, such as copper sulfate, and an inorganic nitrate, such as sodium nitrate. U. S. patent No. 1,954,745 relates to the cleansing of metals by use together of oxalic acid, sodium sulfate and a. sulfonated coal-tar distillate. *C. A.* **28,** 3707 (1934).

Protecting magnesium and its alloys against corrosion. German patent No. 594,062. March 9, 1934. E. VÖLKER.—A protective coating is produced on magnesium, or alloys consisting mainly of magnesium, by subjecting the metal to the action of alternating current in a bath of alkali or alkaline earth hydroxide, preferably at atmospheric temperature. Direct current may be used instead of alternating current, provided that the magnesium or alloy is made the anode. The coating may be colored dark gray by after-treatment with potassium oxalate. *C. A.* **28,** 3317 (1934).

Preventing corrosion. Russian patent No. 32,881. October 31, 1933. G. I. KOTELNIKOV.—Zinc and tin are protected against corrosion by an electrolytic anodic treatment or by the action of alternating current in a solution of sodium sulfide or ammonium sulfide. *C. A.* **28,** 3317 (1934).

New methods of protection from corrosion. R. DOCZEKAL. *Sparwirt.* **11,** No. 1, 20 (1933); *Bldg. Sci. Abstracts* **6,** 165.—The Parker process is described. Variations of weight are shown which were observed with test specimens of steel exposed to various reagents after parkerising, sherardising, coating with tin, nickel, zinc or painting. Results are given of an accelerated corrosion test in which steel protected by various methods, including the Parker process, was sprayed with a corrosive solution and observation made of time required for rust to appear. Reference is made to the Parkolite spray process, the Bonderite process, the Protol process for aluminum, and also to the Udylite process of electrically depositing cadmium.

C. A. **28,** 3367 (1934). G. G.

Painted, lacquered and pickled surfaces and their resistance to corrosion. P. STEEN and O. P. VAN STEEWEN. *Bauing* **14,** 160 (1933); *Bldg. Sci. Abstracts* **6,** 127.—The corrosion resistance of steel, copper and

aluminum surfaces which have not been galvanized but are protected by coatings of oil paint or lacquer, the properties of oils and lacquers which are essential to the prevention of corrosion beneath the paint, and methods of pickling, which, besides affording protection, also produce definite colors, are discussed. *C. A.* **27,** 3367 (1934). G. G.

Determination of the loss in weight in corrosion tests. ALBERT PORTEVIN. *Rev. mét.* **30,** 275 (1933).—The amount of corrosion can be determined by weighing before and after corrosion, by determining the amount of the corrosion products or by determining the weight of the specimen with the products of corrosion. When the latter are gaseous or soluble the problem is simplified. With solid corrosion products they can be dissolved by a reagent not affecting the metal, the latter can be removed, the deposit can be converted into an easily removable substance, or the corrosion layer can be removed by gas evolution. For rust removal a solution containing 30 ml. (22 Bé) hydrochloric acid, 1 ml. 40% formaldehyde, 0.2g. arsenious oxide (As_2O_3), 0.5g. stannous chloride, with water to make up to 100 ml. gives very good results. About 800 ml. should be used for every 100 sq. cm. of the specimen and the solution discarded before it becomes yellowish. Cold solution, continuous stirring and occasional brushing are recommended.

C. A. **28,** 3367 (1934). J. D. G.

The principle of the corrosion of metals. J. GLAYMANN. *Science et ind.* **18,** 48 (1934).—Glaymann shows that corrosion, whatever form it takes, follows the electrolytic theory of metals. From some well-known experiments on the attack of metals by acids, which constitutes the primary form of corrosion, he deduces the following law which can explain numerous cases of corrosion, and more particularly certain cases of corrosion of boilers and water pipes: "The necessary and sufficient condition to permit corrosion of a substance is that it constitutes one or other of the electrodes (most frequently the anode) of a normal electric cell".

C. A. **28,** 3368 (1934). A. PAPINEAU-COUTURE.

Chemical methods of cleaning corroded light metals. M. CHAUSSAIN and H. FOURNIER. *Compt. rend.* **198,** 936 (1934).—The use of aqueous nitric acid for cleaning aluminum and its alloys has been examined by determining the loss of weight of corroded and uncorroded metal in acids at varying temperature, of varying concentration, and acting for varying times. The temperature should be 60-70° C. Loss of metal due to solution increases with dilution to a maximum for about 40% acid, the loss caused by concentrated and 10% acid being approx. the same (80g. per sq. meter per hour at 60° C.), but metal cleaned in concentrated acid is bright and well cleaned; that in 10% acid is dull. As regards time, loss of weight at first increases rapidly, and then becomes steady and proportional to the time, passivity never becoming complete (cf. *C. A.* **25,** 2403 (1931)).

C. A. **28,** 3368 (1934). C. A. S.

Solution of the corrosion products from light and ultra-light alloys. PAUL BASTIEN. *Rev. mét.* **30,** 284 (1933).—Aluminum specimens can be cleaned thoroughly after corrosion by immersion for 30 minutes in concentrated nitric acid heated to 30° C., rinsing and drying. Magnesium alloys clean well in boiling 10-20% solution of chromic acid. Traces of chlorine rapidly increase the corrosion of the base. Their influence is overcome by

addition of silver chromate. *C. A.* **28,** 3368 (1934). J. D. GAT.

Measurement of adherence of electrolytic deposits. P. JACQUET. *Compt. rend.* **198,** 1313 (1934).—A small portion at one end of an elongated metal plate is covered with peptone and copper deposited over the whole to the desired thickness (0.3mm. or more - 0.012 in.-); a central strip is cut through and the peptone-covered end, which is easily detachable (see Monthly Rev. **20,** No. 1, 37 (Sept. 1933)), is attached to a suitable weight or a machine and the force required to detach the remainder measured (cf. *C. A.* **19,** 1992 (1925)). Adhesion to a polished nickel surface thus determined is nearly double that to a mat one. *C. A.* **28,** 3307 (1934).

Apparatus for electroplating the interior of rifled gun barrels. U. S. patent No. 1,953,955. April 10, 1934. E. M. CROUCH.—Structural and mechanical features. *C. A.* **28,** 3672 (1943).

Modern electrodeposition of metal. S. COWPER-COLES. *J. Inst. Production Engrs.* **12,** 79 (March, 1933); *Met. Abstracts* (in *Metals & Alloys*) **4,** 386.—Modern practice in the electrodeposition of copper, iron, zinc, lead, nickel, chromium and cadmium is briefly outlined. Improvements in generators, filters, agitators and methods of pH control and appreciation of the importance of rapid circulation in producing smooth deposits, are responsible for the main advances. Copper sheet can be made with a total energy consumption of 1000 kw. hours per ton by plating on a revolving lead drum at 200-250 amps./sq.ft. and stripping the deposit. Spring-hard material can be made by consolidating the deposit by floating rollers. Copper wire is made by depositing on a mandrel in which a spiral V groove is cut. The crystals in the deposit grow at right angles to the surface and so meet in a line above the apex of the V. The deposit will divide at this point, and can be unwound as a square wire, which needs only a single wire-drawing operation for finishing to shape. *C. A.* **28,** 3308 (1934). G. G.

Linear velocity of crystallisation of the cathode deposit in the electrolysis of certain lead salts. A. GLAZUNOV and E. BARTUNEK. *Chem. Listy* **27,** 172 (1933).—The linear velocity of crystallisation of lead at the cathode in the electrolysis of aqueous lead chloride or lead acetate is a function of their concentration and of the current density.
C. A. **28,** 3308 (1934). B. C. A.

Electroplating as a method of protecting ferrous metals against atmospheric corrosion. MARCEL LÉPINGLE. *Science et ind.* **17,** 423, 455, 495 (1933).—A review, from the theoretical and practical standpoints, of electroplating processes, methods of testing, and effects of impurities.
C. A. **28,** 3309 (1934). A. PAPINEAU-COUTURE.

Determination of the degree of smoothness of metal surfaces. E. FRANKE. *Oberflächentech.* **11,** 25 (1934).—Methods of testing surface smoothness are reviewed; recently an acoustic method has been developed by which a needle is carried over the surface and the vibrations, transformed into acoustic sounds, give a measure of the smoothness; the smoother the surface the higher the sound. The Herbert pendulum is described for measuring relative surface hardness and smoothness. Surfaces with very high smoothness (axles, etc.) can be produced by burnishing, whereby the surface is polished under the high pressure of three rolls. *C. A.* **28,** 3356 (1934).

MILWAUKEE BRANCH

The Milwaukee Branch did not have a meeting in June on account of the Convention, all business was postponed to the July meeting. The meeting held July 12 was one of the best meetings with a record breaking attendance in spite of the hot weather. After the routine, Mr. Kuehl of Two Rivers, Wis., a new member, was initiated by proxy. We also had an application from Roman Binder, son of our librarian, Henry Binder. Roman Binder has attended our meetings for some time but until now he was not eligible. Our membership is holding up well in spite of conditions. We heard reports from our delegates to the convention but as we had a social session the educational report was ordered to be continued to our educational meetings. The picnic committee made its report and Milwaukee Branch will make merry at Wind Lake Sunday July 15th. We have not had a picnic for five years but the old boys want to make merry again. Under the head of new business the elected officers were installed by Mr. Mueller of the Racine Plating Works. This was done in grand style and the members were well pleased by the work done by Mr. Mueller. A rising vote of thanks was given Mr. Mueller for his efforts. The following officers were installed:— Pres., Pat. Sheehan; Vice-Pres., Dexter Rhodes; Secy-Treas., Frank Marx; Librarian, Henry Binder; Asst. Lib., Al Hermanson; and Bob Stuernagel, Jack Geisman and H. Jager as Board of Managers. The veteran Dan Wittig will have a well earned rest as he has served continually for 14 years. He had been elected as a member of the Board of Managers but withdrew. After the business meeting, the party started, lunch and refreshments for all provided by the Board of Managers and Secy. Marx. Old acquaintances were renewed over a glass of the stuff made famous by Milwaukee. Our old friend Rudy Hasucha, a former member of our branch was with us, also many of the old timers. All in all it was a howling success as the yodlers had a chance to exercise their vocal cords. Ray Goodsell, winner of one of the prize awards at the convention was at the piano to help out the yodlers. Milwaukee Branch a year ago was in the red but we are pleased to announce that our treasury is healthy again unless the picnic committee will dig too deep into our pile. Our new officers have pledged to give us their best to make the 1934-35 year a grand success.

FRANK MARX, *Secy.-Treas.*

MILWAUKEE BRANCH PICNIC

The picnic of Milwaukee Branch held Sunday, July 15th at Fries Park, Wind Lake will be remembered for a long time by those that attended, and evidently will be a yearly affair of the Branch. The weather was perfect, and a good time was had by the 175 that attended, the picnic was for members and their families also personal friends. Credit for the huge success goes to Mr. and Mrs. Al. Hermanson and Mr. and Mrs. Dexter Rhodes who arranged and supervised the whole affair, there was not a dull moment from 10 A. M. till dusk, games galore and a spirit of good fellowship prevailed all day. The baseball game was

won by the Racine bunch, score, Racine 24—Milwaukee 15—Bob Steurnagel the umpire was chased after the 4th inning, he was terrible, thinking it was a bowling match. The ladies potato race was won by Mrs. Wm. Haese with Mrs. Steurnagel close second. The crackers and whistling contest was won by Mrs. Wittig. Balloon blowing, Mrs. Wm. Haese first—Mrs. Lexa a close second. Nail driving, Mrs. Stieglitz first, but protested as she is a professional driver. There were many races and games for the boys and girls but the writer could not keep track of the winners.

Men's nail driving contest was won by Rudy Hazucha with Mr. Ulrichson a close second. John Mizewski one of our oldest members was still pounding his nail when the party broke up.

The beach was crowded all day by the kids, only one of the grown ups ventured into the water, it was our old friend Ed. Werner and the fish sang driven from home when he hit the water.

The prize for the largest family attending went to Mr. and Mrs. Rudy Hazucha and the five little Hazuchas. We had a large delegation from Racine and the cities close by. When taps was sounded there was a large crowd left to finish the wet refreshments. Believe it or not but the men's milk drinking contest was won by Jack Geisman.

DAN WITTIG.

WATERBURY BRANCH

The monthly meeting of Waterbury Branch, which was held Friday evening, July 13th, was slimly attended, and was of short duration, only routine business being transacted. The old bugaboo, humidity, which made things interesting for some of the "boys" during the day, evidently kept after them during the evening, as many of the regulars were conspicuous by their absence.

Walter R. Hibbard and E. T. Candee, the latter assistant librarian of the local Branch, have been granted a patent on refining hard tin; the same being assigned The American Brass Co.

L. H. GUILFOILE, *Secretary.*

BRIDGEPORT BRANCH

The Bridgeport Branch held its regular monthly meeting on Friday evening, July 6, at eight o'clock, in the Chamber of Commerce Rooms at the Stratfield Hotel. The minutes of the last meeting were read and accepted.

Ray O'Conner, Chairman of the Banquet Committee of the Bridgeport Branch for the banquet held in Hartford between the Waterbury, Hartford and Bridgeport Branches, reported that it was a social as well as a great financial success.

The communication from H. A. Gilbertson concerning the report for the year was read and ordered placed on file.

Delegates who attended the Convention gave their reports.

Ray O'Conner was appointed as Chairman of the next Convention to be held in Bridgeport.

A motion was made and seconded that the annual outing of the Branch be held during the month of September. A committee was appointed and full reports are expected at the next meeting. The committee appointed includes Eugene Phillips, Ben Kusterer and Joe Sterling, headed by Al. Rosenthal.

WM. H. FLAHERTY, *Secy.*

HARTFORD CONNECTICUT VALLEY BRANCH

The Hartford-Conn. Valley Branch held its regular meeting on Monday evening, June 25, 1934, at the home of Mr. E. M. Stephenson, 244 Whiting

Lane, West Hartford, Conn. The meeting was opened at 8:30 p. m. with Past Pres. Beloin in the chair. Minutes of the previous meeting were read and accepted. All communications were read and placed on file. No bills were presented.

At this meeting our new officers were elected as follows:—Pres., Mr. Jos. St. Pierre; Vice-Pres., Mr. Jos. Pietro; Sec.-Treas., Mr. V. E. Grant; Librarian Mr. W. E. Bancroft.

A Board of Managers consisting of Mr. H. K. MacFadyen, Mr. W. E. Bancroft, and Mr. W. D. MacDermid was elected.

Two applications were received and voted to take the usual course. One was for active membership by Mr. Christie of the Veeder-Root Co., of Bristol, and one for associate membership by Mr. Smith of R. Wallace & Sons, of Wallingford, Conn.

It was voted at this meeting to suspend all members who were in arrears. These suspended members may be voted back into the branch by paying up all back dues and making application to be reinstated by vote of the Branch according to the rules as stated in the Constitution.

After the regular business, we received reports of the Convention by our delegates.

A very delicious lunch was served by Mr. Stephenson, which was thoroughly enjoyed. In conclusion he was given a rising vote of thanks.

It was voted to hold no meeting during July and August.

V. E. GRANT, *Sec'y.*

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BRANCH DIRECTORY

ANDERSON

Meets first Monday of every month at 7.30 p. m. at the Anderson, Indiana, Y.M.C.A. Secretary, G. M. Cole, 104 Beverly Terrace, Anderson, Indiana.

BALTIMORE-WASHINGTON

Meets at Bureau of Standards, Washington D. C., the first Saturday of each month, Secretary, Irvin H. Hahn, 207 S. Sharp St., Baltimore, Maryland.

BOSTON

Meets at American House, Boston, Mass., first Thursday each month. Secretary, A. W. Garrett, 100 King St., Dorchester, Mass.

BRIDGEPORT

Meets first and third Fridays of each month at Chamber of Commerce Rooms, Stratfield Hotel, Secretary-Treasurer, Wm. H. Flaherty, 691 Maplewood Ave., Bridgeport, Conn.

CHICAGO

Meets second Saturday of each month, at 8 p. m., Atlantic Hotel, 316 S. Clark St., Secretary, James Hanlon, 3004 N. Whipple St., Chicago, Illinois.

CINCINNATI

Meets every Thursday, 7.30 p. m., at Vocational Training School, Spring and Liberty Sts. Secretary, Al. Yeager, 2021 Sherman Ave., Norwood, Ohio.

CLEVELAND

Meets first Saturday of each month at Carter Hotel, Secretary, W. D. Scott, 260 Sunset Road, Aron Lake, Ohio.

DAYTON

Meets first Saturday of each month at the Y.M.C.A., Dayton, Ohio. Secretary, Ward Protsman, 141 Westwood Ave., Dayton, Ohio.

DETROIT

Meets the first Friday of each month at the Hotel Statler, T. C. Eichstaedt, Secretary. 81 Marston Ct., Detroit, Mich.

GRAND RAPIDS

Meets second Thursday of each month, 7.30 p. m., at Cody Hotel, 1 Division Ave., South. Secretary, Chas. S. Whalley, 931 Pine Ave., N. W., Grand Rapids, Mich.

HARTFORD-CONNECTICUT VALLEY

Meets fourth Monday in each month alternately at the Chamber of Commerce, 815 Main St., Hartford, and the Chamber of Commerce, 134 Chestnut St., Springfield. Secretary, Vernon Grant, 32 Jennings Road, Bristol, Conn.

LOS ANGELES

Meets second Wednesday of each month at 6.30 p. m., at the Rosslyn Hotel, 2nd floor, N.W. Cor. of 5th and Main Sts. Secretary, Earl Coffin, 2910 S. San Pedro St., Los Angeles.

MILWAUKEE

Meets second Thursday of each month at Cor. 3rd and Highland Ave. Secretary, Frank J. Marx, 1431 W. Cherry St., Milwaukee, Wis.

MONTREAL

Meets second and fourth Friday of each month. at 1437 Aylmer St., Montreal, Quebec, Canada. where the Secretary-Treasurer, Mr. Charles Doherty, can be found at any time.

NEWARK

Meets first and third Fridays of each month, at Newark Elk's Club, Broad St., Newark, N. J., at 8 p. m. Secretary-Treasurer, Geo. Reuter, P. O. Box 201, Newark, N. J.

NEW YORK

Meets second and fourth Fridays of each Month, in the World Building, Park Row, New York City, N. Y. Secretary-Treasurer, Frank MacStoker, 25 Princeton St., Garden City, L. I., N. Y.

PHILADELPHIA

Meets third Friday of each month, in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts. Secretary, J. E. Underwood, 927 Middlesex St., Gloucester, N.J.

PITTSBURGH

Meets first Friday of each month, at 8 p. m. at Keystone Club. Secretary, S. E. Hedden, 227 Fifth St., Aspinwall, Pa.

PROVIDENCE-ATTLEBORO

Meets first and third week of each month. Notice by card. Secretary, J. H. Andrews, 19 Rosedale St., Providence, R. I.

ROCHESTER

Meets third Friday of each month, at Hotel Seneca, Secretary, J. R. Elster, 295 Rawlinson Road, Rochester, New York.

SAN FRANCISCO

Meets at Plaza Hotel, San Franciso. Secretary, H. W. McKibben, 310 Tehama St., San Francisco, Cal.

ST. LOUIS

Meets second Frday of each month, at the Plant of the Lassalco Co., 2828 LaSalle St. Secretary, C. T. McGinley, 8214 Fairham Ave., University City, Mo.

TOLEDO

Meets first Thursday of each month, at Toledo Secor Hotel, Cherry and Page Sts., Secretary, W. W. Weiker, 2228 Middlesex, Toledo, Ohio.

TORONTO

Meets fourth Monday of each month, at Canadian Foresters' Hall, 22 College St., Room No. 2. Secretary, H. W. Graham, 26 Beatrice St., Toronto, Ontario, Canada.

WATERBURY

Meets second Friday of the month, at Engineers Hall, No. 11 East Main St. Secretary, Wm. F. Guilfoile, 14 Oakland Ave., Waterbury, Conn.

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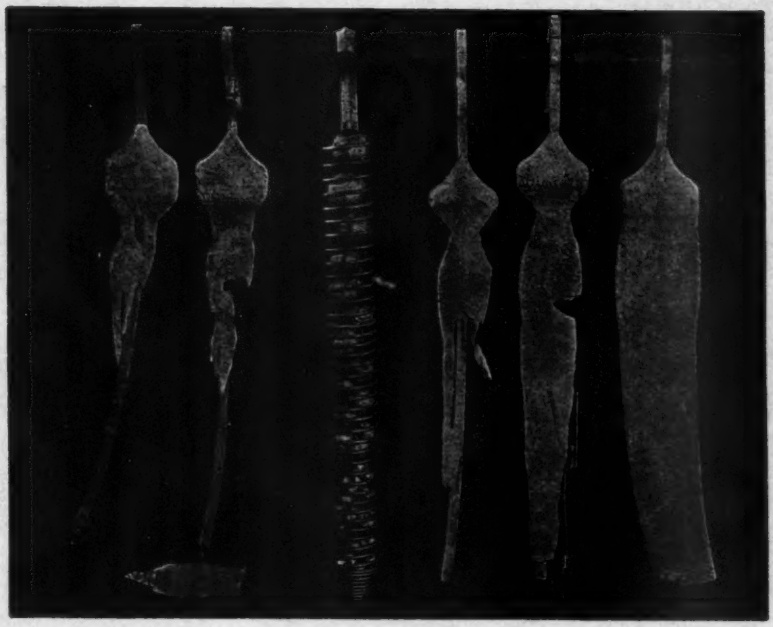

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